Deltares USA

Date
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Proposal for

Analysis and Interpretation of Pesticides and Toxicity Monitoring data in the Sacramento-San Joaquin Delta

Sandhill cranes on Staten Island, California

Annex 1 detailed proposal content

1. Contractor information

Deltares USA, Inc., a Maryland not-for-profit non-stock corporation, will be the prime contractor for this work and is closely aligned with Stichting Deltares[(1)] in the Netherlands. Deltares (www.deltares.nl/en/) is an independent, institute for applied research in the field of water, subsurface and infrastructure. Throughout the world, we work on smart solutions, innovations and applications for people, environment and society. Our main focus is on deltas, coastal regions and river basins. Managing these densely populated and vulnerable areas is complex. We are convinced that it is only by forging alliances that we can tackle the challenges we face. That is why we collaborate closely with governments, businesses, other research institutes and universities at home and abroad. Moreover, we do not keep our breakthroughs to ourselves; we share them with others. Development of new knowledge depends on sharing the knowledge we have. Government authorities, community organisations and the commercial sector benefit from our research and specialist consultancy. Our activities always aim to maximize knowledge development and knowledge transfer.
Our motto is Enabling Delta Life. As an applied research institute, the success of Deltares can be measured in the extent to which our expert knowledge can be used in and for society. For Deltares the quality of our expertise and advice is foremost. Knowledge is our core business.
Our research is always a response to the needs of society. We focus on five themes:

- Flood Risk
- Ecosystems and Environmental Quality
- Water and Subsoil Resources
- Delta Infrastructure
- Sustainable Delta Planning

All contracts and projects, whether financed privately or from strategic research budgets, contribute to the consolidation of our knowledge base. Furthermore, we believe in openness and transparency, as is evident from the free availability of our software and models. Open source works, is our firm conviction. Deltares employs over 800 people with 29 nationalities and is based in Delft and Utrecht in the Netherlands. Besides we have a number of offices around the world, namely in Brasil, Indonesia, Singapore and the United Arab Emirates. Next to that we have an affiliate in the United States.

Within the theme Ecosystems and Environmental Quality, Deltares is developing knowledge about the quality of soil and water systems, and making that knowledge available through model and information systems for policymakers, managers and users. The system knowledge is also being used for sustainable natural solutions as an alternative to the traditional hard hydraulic engineering approach, for technological innovations to improve the protection of water on soil systems, and for the exploitation of ecosystem services. Within Deltares, more than 100 people are working in the field of water quality and ecology of inland and marine surface waters, and groundwater.

2. Contractor experience

During the years, Deltares has gained a substantial amount of experience in the field of environmental impact assessment of pesticides within a number of projects. The aim of the projects ranged from developing and evaluating monitoring programs to performing ecological risk assessments based upon the results obtained. Besides Deltares has performed a number of projects in which the results of both bioassays and chemical analyses were evaluated in parallel. Since a few years, Deltares is also active in California and especially in the Sacramento-San Joaquin Delta. Clients range from NGO's to water authorities to national ministries, both national as international. Taking all these projects into account, we think that Deltares is an outstanding party to perform the tasks described in the Request for Proposal. In the following section we will highlights some of these projects.

Monitoring of pesticides in Staten Island, California
After a visit to the Nature Conservancy at Staten Island in 2014, Deltares was asked by The Nature Conservancy to develop, perform and evaluate a monitoring program dedicated to pesticides for the Nature Reserve Staten Island, a hibernating sanctuary for cranes in the Mokelumne River. At this island also a number of crops are grown. Aim of this program was to analyse the influence on the water quality of pesticides, originating both from inside and outside the island. Analyses were done during summer and winter, thereby including all relevant emission routes (spray drift, run-off and leaching). For this, continuous sampling using the methodology of passive sampling was used. The concentrations obtained by the chemical analyses were compared with water quality objectives. Based on these outcomes a number of problematic compounds were identified, and the crop rotation on the Island was changed. Results were shared with the California Department of Pesticide Regulation which took a high interest in the obtained results. The monitoring program is still ongoing, and possibilities to enlarge the monitoring program also outside Staten Island are explored.
Contact information:
The Nature Conservancy
Mr   Dawit M. Zeleke, Senior Advisor Conservation & Agriculture
E-mail address: dzeleke@tnc.org
Phone number: (530) 518-7244

Development and evaluation of the National Monitoring Program Pesticides in the Netherlands
Although quite a number of measures have already been taken during the years to reduce the emissions of pesticides to surface waters in the Netherlands, the exceeding of water quality objectives by pesticides in the surface water is still substantial. Therefore a new national monitoring program was developed in 2013 with the aim to monitor the environmental pressure caused by pesticides on a constant number of locations during 10 years. Deltares was appointed by the Dutch ministry of infrastructure and environment to develop this monitoring program. In conjunction with the regional water authorities in the Netherlands, locations were chosen in such a way, that they were predominantly influenced by one crop and that no other dominant sources like sewage treatment plants were in the vicinity. In this way, the likelihood that a water quality objective exceedance is caused by a certain application is enlarged, information that can be used during the authorisation process of pesticides. In total 98 locations were selected for this monitoring program, from which the results are evaluated in a yearly report, written by Deltares. Concentrations of pesticides are compared with their water quality objectives. In this way hotspots, problematic compounds and crops are identified. Besides, both the locations and the

pesticides measured are evaluated and, when necessary, adjusted on a regular basis. Results are presented and discussed on a yearly symposium, organised by Deltares.
Contact information
Ministry of Infrastructure and the Environment
Mr. Dennis Kalf, senior advisor pesticides and water quality
Email address: dennis.kalf@rws.nl
Tel: 0031 06 53691890

Evaluation and optimisation pesticide monitoring programs of regional water authorities
Parallel to this national monitoring program we have developed, Deltares has also advised a number of regional water authorities in the Netherlands in optimising their pesticide monitoring program, based on results from the recent past. Parameters like frequency, timing, locations and selected compounds were statistically analysed, when possible, and trends were evaluated. General take home message: regional water authorities try to answer too many questions simultaneously with their monitoring program, resulting in the conclusion that none of the questions can be answered in an adequate way.

Comparison of results of Bio assays and chemical analysis
Next to knowledge and expertise on the evaluation of chemical analyses of pesticides, the proposed team has a lot of experience on the development, performance, and evaluation of bio-assays as an indicator of water quality. Members of the team have been involved in the development of Whole Effluent Assessment and the application of bioassays in surface waters in the last 15 years. A number of international practical programs on bio-assay application were coordinated by members of the team. In some of these practical programs, a comparison between bio assay results and chemical analyses was performed, in order to explain the obtained results, see for instance this conference paper.
Specific for pesticides, a study is performed in the Netherlands, commissioned by the Dutch Ministry of Infrastructure and Environment, in which the emissions of pesticides to the aquatic systems, used in 2 different crops were modelled. The ecological risk of these modelled concentrations was calculated. Deltares was responsible for performing a number of the different methods to calculate the potential risk of the multiple stresses caused by parallel and sequential applications of pesticides, the result can be found in this report.

Biogeochemical modelling in San Francisco Bay-Delta
Next to the projects Deltares is performing regarding the environmental impact of pesticides, Deltares is at the moment also collaborating with the San Francisco Estuary Institute (SFEI) in a project named “Biogeochemical modelling in San Francisco Bay-Delta with D-FLOW FM & DELWAQ”. The aim of this project is to develop and apply Deltares’ 3D biogeochemical models of the San Francisco Bay-Delta using D-FLOW FM and DELWAQ, to simulate nutrient cycling, primary production, and dissolved oxygen conditions to inform upcoming nutrient management decisions. Recently, scientists at the SFEI have been using D-FLOW FM and DELWAQ for early simulations and model testing. Through this project, scientists from Deltares and SFEI will work collaboratively to evaluate model performance and improve model skill. This project builds on the ‘San Francisco Bay Delta Community Model’, also in D-FLOW FM (http://www.d3d-baydelta.org/).
Contact information:
San Francisco Estuary Institute
David Senn, PhD, program Director, senior scientist
Email adress: davids@sfei.org
Tel: (510) 746-7366

3. Professional Team

In this section we propose the formed team based on the expertise asked in the Request for Proposal. More detailed information about the team members can be found in the individual resumes at the end of this section.

The team will operate from our Deltares office in Utrecht, the Netherlands, see for more information https://www.deltares.nl/en/contact/offices/. Besides, our affiliate in the United States (https://www.deltares.nl/en/contact/affiliate-entity/) will serve as a contact point and will perform the final review of the deliverables.
Although the team will not execute the project in the United States, we are convinced that this will not hamper the process of the project in any way. Several of the team members have visited the Delta area in the recent past, and at the moment we are already active in this area in the field of pesticide monitoring for several years. This recent project has provided us with a lot of detailed information about the pesticides present at a number of monitoring locations in the Bay area and the potential risks associated with them. Besides, we are also cooperating with the SFEI in the field of water quality.
A number of the scheduled meeting will be done by telephone or videoconferencing. To overcome the challenge of long distance we have also included two face to face meetings, adjacent to two symposia, which will take place in Sacramento in the course of the project, and which we had already planned to visit, namely the Delta Bay conference from 9-12 September 2018 and the SETAC conference from 4-8 November 2018.

The proposed team will consist of the following members:
- Dr. Erwin Roex, senior advisor water quality, PhD in aquatic toxicology, bio assays, monitoring, analyses and environmental risk assessment of pesticides, experienced project manager, based in Utrecht, The Netherlands.
- Dr. Jasperien De Weert, senior advisor, PhD in environmental technology, experience in chemical analyses and monitoring of pesticides, bio assays, based in Utrecht, The Netherlands.
- Dr. Joachim Rozemeijer, senior advisor water quality, PhD in Physical Geography, hydrologist, experience in environmental statistics related to the design of monitoring programs, based in Utrecht, The Netherlands.
- Janneke Klein, MSc Physical Geography, experienced data base specialist and environmental statistics, based in Utrecht, The Netherlands.

The project team is constructed in such a way that all the relevant fields of expertise are represented by at least two members of the team.
Having the broadest experience in the field of pesticides and bioassays, ranging from conducting and evaluating both bioassays and chemical analyses to performing risk assessment, Erwin Roex will act both as the principal-in-charge as well as the project manager. He is in principle also the member of the professional team who will be attending the meetings with stakeholders. Dr. Jasperien de Weert will act as a vice project leader, in absence of the proposed project leader. In the next table the other different roles in the project team are displayed.

Role/expertise	**name**
Principal-in-charge	Erwin Roex
Project manager	Erwin Roex
Water quality	Erwin Roex, Jasperien de Weert, Janneke Klein, Joachim Rozemeijer
Pesticides	Erwin Roex, Jasperien de Weert, Janneke Klein
Hydrology	Janneke Klein, Joachim Rozemeijer
Chemistry	Jasperien de Weert, Erwin Roex
Ecotoxicology	Erwin Roex, Jasperien de Weert
Environmental Statistics	Joachim Rozemeijer, Janneke Klein.

We have checked that the above mentioned members of the project team are available at the commitment level required for the project during the course of the project.

Dr. Erwin Roex

Senior advisor water quality at Deltares, with a broad experience in environmental risk assessment of pesticides, ranging from aspects related to monitoring to multiple risks assessment of pesticides. After finishing his PhD in ecotoxicology at the Vrije Universiteit in Amsterdam, he worked at the Dutch national Institute of Public Health and the Environment, concerned with environmental risk assessment of pesticides related to the authorization. In 2002, he moved to the Institute for Inland Water Management and Waste Water Treatment, as project leader of the Practical Program on Whole Effluent Assessment, both in a national and international context. During this time he gained a lot of experience about the pros and cons of bio assay testing. During this time, and after starting at Deltares, he also became an advisor to the Ministry of Environment with respect to pesticides, participating in a number of projects involving risk assessment of pesticides in different frameworks, and later on also regarding effective monitoring of pesticides. Next to advising regional water authorities on monitoring strategies, he was involved in the set-up of a nationwide monitoring program for pesticides, and is also still involved in the yearly evaluation of this program. Since 2015, he performs a monitoring program on pesticides on Staten Island, a nation reserve in the Mokelumne River. Together with the nature Conservancy, results are evaluated and communicated to relevant stakeholders, like the California Department of Pesticide Regulation. During his 20 years of experience in the field, Erwin has become an experienced project leader. Additional information can be found on my Linkedin profile and google scholar profile.

Education

1988 - 1995 Msc - Wageningen University - Biology

Employment Record

2008-present	**Deltares** Senior advisor/researcher water quality
2002 - 2008	**Institute for Inland Water Management and Waste Water Treatment** Project leader Whole effluent assessment
2000 - 2002	**National Institute of Public Health and Environment** advisor ecological risk assessment of Pesticides
1996 - 2000	**Vrije Universiteit,** PhD student Acute versus chronic toxicity of compounds with a different mode of action to the zebrafish (*Danio rerio*)

Relevant projects

Monitoring of pesticides using on Staten Island, CA (2015-present)
Client: The Nature Conservancy, United States
As project leader performing a yearly monitoring program with passive sampling to characterize the influence of pesticides within Staten Island, a hibernating area for cranes.

Evaluation several agricultural monitoring programs (2012-2013)
Client: Dutch regional water authorities

Evaluation of the design of agricultural monitoring programs, based on the results of last years of the water authorities.

Monitoring of Pesticides (2009-2016)
Client: Dutch Ministry of Infrastructure and Environment
The purpose of this project is to advise the ministry and regional water authorities on aspects concerning the monitoring of pesticides.
Activities performed: project leader, development of a monitoring tool, based on actual use of pesticides in the Netherlands, construction of a nationwide monitoring program for pesticides.

Advise on settting WFD Environmental Quality Standards (2008-2013)
Client: Dutch Ministry of Infrastructure and Environment
Advising the ministry on aspects concerning the environmental risk assessment of substances within the European Water Framework Directive (WFD).
Activities performed: advice on higher tier risk assessment of substances within the WFD, organisation of international workshop on use of passive sampling within the WFD, harmonising risk assessment of Plant Production Products between WFD and Pesticides Directive.

Implementing Whole Effluent Assessment for offshore industry for OSPAR region (2009-2012)
Client: Directorate-general for Public Works and Water Management
Within this project a risk based approach was developed for discharges from the offshore oil & gas industry (produced water) within the OSPAR region, based on Whole Effluent Assessment (bio assays) and chemical analysis, and a comparison was made between the two methods.

Relevant reports

- Roex, E.W.M., D. Giessen, H. Beeltje (2016) Final report results passive sampling Staten Island CA, Deltares report 1220203-000
- R. Luttik, M.I. Zorn, T.C.M. Brock E.W.M. Roex, A.M.A. van der Linden (2017) Multiple stress by repeated use of plant protection products in agricultural areas. RIVM report 2016-0152. https://www.rivm.nl/bibliotheek/rapporten/2016-0152.pdf
- De Weert, J, Klein, J, Roex, E, Klein, M ‘t Zelfde, WLM Tamis (2017) Evaluation National Monitoring Program Plant Production Products 2015. Deltares rapport 1230099-004 (in Dutch)
- Roex, E, J Klein, J de Weert, M ‘t Zelfde, WLM Tamis (2016) Evaluation National Monitoring Program Plant Production Products 2014. Deltares rapport 1220098-004 (in Dutch).
- de Weert, J., E. Roex, J. Klein, G. Janssen (2014) Design National monitoring program Plant Production Products. Deltares rapport 1207762-008 (in Dutch).
- Rozemeijer, J. J. de Weert, E. Roex (2014) Evaluation agricultural monitoring program waterboard of Rijnland. Deltares rapport 1208885-000 (in Dutch).
- E. Roex, J. Rozemeijer, J. de Weert (2013) Evaluation agricultural Monitoring program waterboard of Rivierenland. Deltares rapport 1207376-000 (in Dutch).
- TCM Brock, GHP Arts, TEM ten Hulscher, FMW de Jong, R Luttik, EWM Roex, C.E. Smit, P.J.M. van Vliet (2011) Aquatic effect assessment for plant protection products: A Dutch proposal that addresses the requirements of the Plant Protection Product Regulation and the Water Framework Directive. Alterra report 2235, http://edepot.wur.nl/187906

Dr Jasperien de Weert

Senior scientist with over 17 years of experience in the field of environmental quality and 10 years in the field of passive sampling. She did her MsC Environmental Technology and her PhD at the Wageningen University in the Netherlands, specializing in biodegradation and bioavailability of organic compounds in sediments. After finishing her PhD in 2009, she continued her career at Deltares as scientist and consultant. She has 12 publications and had several reports published in the field of water quality monitoring, mainly regarding pesticides. The last years she specialized on monitoring of water quality with new techniques like passive sampling of monitoring of e.g. pesticides and pharmaceuticals.

She is advising regional authorities about monitoring strategies of pesticides and is involved in the evaluation of data of pesticide monitoring. Since 2013 she became also an advisor to the Ministry of Environment with respect to pesticides. In this role, she set-up a nationwide monitoring program for pesticides in collaboration with the Ministry of Infrastructure and Environment and the Dutch local water authorities and since 2016 she is the project leader of the yearly evaluation of the monitoring data for this program.

During her PhD she also did work on bio assays and was last years involved in project in which chemical monitoring was combined with the monitoring with bioassays.

Education

1994 - 2000	Msc - Wageningen University – Environmental Technology

Employment Record

2009-present	**Deltares** Senior advisor/researcher water quality
2004 - 2009	**TNO, Built Environment and Geosciences and Wageningen University, section of environmental technology** PhD Candidate “Fate of the estrogen nonylphenol in river sediment: availability, mass transfer and biodegradation”
2001-2004	**Consultancy company HMB-Groep** Consultant on soil remediation

Relevant projects

Evaluation several agricultural monitoring programs (2013-2014)
Client: Dutch regional water authorities
Evaluation of the design of agricultural monitoring programs, based on the monitoring results of pesticides and nutrients of past years of the water authorities.

Monitoring of Pesticides (2012-present)
Client: Dutch Ministry of Infrastructure and Environment

The purpose of this project is to advise the ministry and regional water authorities on aspects concerning the monitoring of PPP and perform the yearly data evaluation of the monitoring data of the nationwide monitoring program for pesticides.
Activities performed: since 2016 project leader, development of a monitoring tool, based on actual use of pesticides in the Netherlands

Time-Integrative Passive sampling combined with Toxicity Profiling (TIPTOP (2014-2016)
Client: Cefic
TIPTOP evaluated a combined strategy of suitable passive sampling and toxicity profiling techniques for the assessment of adverse toxic effects of chemicals on ecological quality of surface waters. Activities performed: performing passive sampling monitoring and evaluating the data of the combination of the chemical and bio-assay data.

Relevant reports/publications

- De Weert, J, Klein, J, Roex, E, Klein, M 't Zelfde, WLM Tamis (2017) Evaluation National Monitoring Program Plant Production Products 2015. Deltares rapport 1230099-004 (in Dutch)
- Roex, E, J Klein, J de Weert, M 't Zelfde, WLM Tamis (2016) Evaluation National Monitoring Program Plant Production Products 2014. Deltares rapport 1220098-004 (in Dutch).
- T. Hamers, J. Legradi J, N. Zwart, F. Smedes, J. de Weert J, E.J. van den Brandhof, D. van de Meent, D. de Zwart (2016) Time-integrative passive sampling combined with toxicity profiling (TIPTOP): An effect-based strategy for cost-effective chemical water quality assessment. Final report of the LRI-ECO23 project. Institute for Environmental Studies, VU University Amsterdam, Amsterdam, TheNetherlands.
- de Weert, J., E. Roex, J. Klein, G. Janssen (2014) Design National monitoring program Plant Production Products. Deltares rapport 1207762-008 (in Dutch).
- Rozemeijer, J. J. de Weert, E. Roex (2014) Evaluation agricultural monitoring program waterboard of Rijnland. Deltares rapport 1208885-000 (in Dutch).
- E. Roex, J. Rozemeijer, J. de Weert (2013) Evaluation agricultural Monitoring program waterboard of Rivierenland. Deltares rapport 1207376-000 (in Dutch).
- J. de Weert, A. de la Cal, H. van den Berg, A. Murk, A. Langenhoff, H. Rijnaarts, T. Grotenhuis (2008) Bioavailability and biodegradation of nonylphenol in sediment determined with chemical and bio analysis. Environ. Toxicol. Chem. Vol. 27, pp 778-785

Dr. Joachim Rozemeijer

Joachim Rozemeijer has been working for Deltares since 2002 as a researcher/advisor in hydrology and water quality. From 2002 until 2006, he worked on various projects dealing with monitoring, water- and solute transport, groundwater-surface water interactions and water conservation in agriculture. He coordinated the STROMON-project (part of the EU project AQUATERRA) that aimed to assess the regional-scale contribution of groundwater to surface water quality.

From 2006 until 2010, Dr. Rozemeijer worked on his PhD-project DYNAQUAL. The project involved a multi-scale fieldwork campaign in an agricultural catchment. The overall conclusion was that changes in flow route contributions induced by weather variations are the main driver for dynamics in water quality.

From 2010 Dr. Rozemeijer coordinated several Deltares projects on water quality monitoring, agricultural drainage, and effect quantification of mitigation options. He is coordinator of the Ecosystem Monitoring and Modelling Strategic Research Program at Deltares. Together with regional Water Authorities, he initiated the National Monitoring Network for Agricultural Headwaters (MNLSO), which is used to report on the effects of the Dutch manure Policy to the European Government. Dr. Rozemeijer developed the Nitrate-app for quick, easy and cheap nitrate measurements by farmers and citzens. He works with the Californian State Water Resources Control Board and with Iowa State University on projects implementing this technology in the US.

Additional information can be found on my Linkedin profile and Research gate profile

Education

1997-2002	Msc – University of Utrecht, Physical Geography

Employment Record

2010-present	**Deltares** Senior Researcher / Advisor Hydrology and Water Quality
2006 - 2010	**Utrecht University, department of Physical Geography / Deltares** PhD-candidate “Dynamics in groundwater and surface water quality”
2002 - 2006	**TNO, Business Unit Groundwater and Soil** Physical Geographical Hydrologist

Relevant projects

Pilot Nitrate-App California (2017-present)
Client: California State Water Control Board
Training, sampling protocol and data interpretation for a Nitrate App pilot by the State Water Resources Control Board testing domestic water wells around San Luis Obispo.

Several evaluations of agricultural monitoring programs at regional Water Boards (2012-present)
Clients: Water Board Rijnland, Water Board Friesland, Water Board Rivierenland
Assessment of water quality data from agricultural monitoring programs; data-processing, data-visualisation, data-interpretation, reporting.

Evaluation of the Dutch Manure Policy (2011-2013 and 2016-2017)
Client: Dutch Ministry of Infrastructure and Environment
Contribution to the ex-post evaluation of the Dutch Manure Policy based on nutrient data from the Monitoring Network for Agriculture Specific Headwaters

Salinity Forecasting and Water Quality Monitoring System Vietnam (2016-present)
Client: International Fund for Agricultural Development (IFAD)
Design of a real time monitoring network and data platform for salinity and water quality in the provinces of Ben Tre and Tra Vinh in the Mekong Delta in Vietnam.

SO-EMM Management (2014-present)
Client: Dutch Ministry of Infrastructure and Environment
Management of the Deltares Strategic Research Program of ‘Ecosystem Monitoring and Modeling’.

Nutrients Monitoring Network for Agriculture-Specific Surface Waters (2012-present)
Client: Dutch Ministry of Infrastructure and Environment
Monitoring network design, data collection, and data interpretation of a new monitoring network concerning the effects of Dutch manure legislation on surface water quality.

Selected publications

Groundwater-surface water relations in regulated lowland catchments; hydrological and hydrochemical effects of a major change in surface water level management
J. Rozemeijer, J. Klein, D. Hendriks, W. Borren, M. Ouboter, W. Rip.
Submitted to Hydrological Earth Systems Sciences (November 2017)

Sensors in the Stream: The High-Frequency Wave of the Present
M. Rode, A. Wade, M. Cohen, R. Hensley, M. Bowes, J. Kirchner, G. Arhonditsis, P. Jordan, B. Kronvang, S. Halliday, R. Skeffington, J. Rozemeijer, A. Aubert, K. Rinke & S. Jomaa.
Published in Environmental Science and Technology (August 2016)

Water quality status and trends in agriculture dominated headwaters; a national monitoring network for assessing the effectiveness of national and European manure legislation in The Netherlands
J.C. Rozemeijer, J. Klein, H.P. Broers, T.P. van Tol-Leenders & B. van der Grift
Published in Environmental Monitoring and Assessment (September2014)

Dynamics in groundwater and surface water quality, driving processes and consequences for regional water quality monitoring.
J.C. Rozemeijer & Y. van der Velde
Published in Fundamental and Applied Limnology (June 2014)

Application and evaluation of a new passive sampler for measuring average solute concentrations in a catchment scale water quality monitoring study
J.C. Rozemeijer, Y. van der Velde, H. de Jonge, F.C. Van Geer, H.P. Broers & M.F.P. Bierkens
Published in Environmental Science and Technology (January, 2010)

Janneke Klein

Janneke Klein is working for Deltares since 2006 as a researcher/advisor surface and groundwater quality. In her first period at Deltares she focussed on studies related to the spatial geochemical characterization of the subsurface and groundwater, especially with the characterization of the reaction capacity of shallow aquifer sediments in geologically different regions in the Netherlands. Another important study she was involved in was to deduce natural background levels for groundwater; these natural background levels contribute to the threshold values used in the Water Framework Directive.

From 2008 Janneke is working on different subjects, ranging from source analyses of pollutants in surface water, the effects of human activities on surface water and groundwater, water quality monitoring, data analyses of surface and groundwater quality and the use of ecosystem services to help decision making in managing groundwater.

In 2010 she initiated the National Monitoring Network for Agriculture Dominated Headwaters. This monitoring network is used for evaluating the Dutch manure policy by assessing the water quality status and trends in agricultural-dominated headwaters. Since 2013 Janneke is project leader of this project. She was also involved in the set-up of a nationwide monitoring program for pesticides in collaboration with the Ministry of Infrastructure and Environment and the Dutch local water authorities, and is involved in the yearly evaluation of the monitoring data for this program.

Education

1999-2004	Msc – University of Amsterdam, Physical Geography

Employment Record

2006-present	**Deltares** Researcher / Advisor Ground and Surface Water Quality
2005 - 2006	**Grondslag** Engineering agency in soil quality (Woerden, The Netherlands)

Relevant projects

Monitoring of Pesticides (2012-present)
Client: Dutch Ministry of Infrastructure and Environment
The purpose of this project is to advise the ministry and regional water authorities on aspects concerning the monitoring of PPP and perform the yearly data evaluation of the monitoring data of the nationwide monitoring program for pesticides.

Water quality in the agricultural land in the Waterboard of Rijnland, Netherlands (2017)
Client: Water Board Rijnland,
Assessment of water quality data for nutrients and Plant Production Products from agricultural monitoring programs; data-processing, data-visualisation, data-interpretation, reporting.

Evaluation of the Dutch Manure Policy (2011-2013 and 2016-2017)
Client: Dutch Ministry of Infrastructure and Environment
Contribution to the ex-post evaluation of the Dutch Manure Policy based on nutrient data from the Monitoring Network for Agriculture Specific Headwaters

Nutrients Monitoring Network for Agriculture-Specific Surface Waters (2012-present)
Client: Dutch Ministry of Infrastructure and Environment
Monitoring network design, data collection, and data interpretation of a new monitoring network concerning the effects of Dutch manure legislation on surface water quality.

Selected publications

De Weert, J, Klein, J, ‘t Zelfde, M, Tamis WLM (2018) Evaluation National Monitoring Program Plant Production Products 2016. Deltares report 11200585-003-BGS-0001 (in Dutch)

Klein, J., Rozemeijer, J., De Weert, J., Ball, S. (2017) Water quality in agricultural areas in Rijnland 2014-2016. Deltares report 11200502-000-BGS-0004 (in Dutch)

Rozemeijer, J., Klein, J., Hendriks, D., Borren, W., Ouboter, M., Rip, W. (2017) Groundwater-surface water relations in regulated lowland catchments; hydrological and hydrochemical effects of a major change in surface water level management. Submitted to Hydrological Earth Systems Sciences

De Weert, J, Klein, J, Roex, E, Klein, M ‘t Zelfde, WLM Tamis (2017) Evaluation National Monitoring Program Plant Production Products 2015. Deltares report 1230099-004 (in Dutch)

Roex, E, J Klein, J de Weert, M ‘t Zelfde, WLM Tamis (2016) Evaluation National Monitoring Program Plant Production Products 2014. Deltares rapport 1220098-004 (in Dutch).

De Weert, J., E. Roex, J. Klein, G. Janssen (2014) Design National monitoring program Plant Production Products. Deltares report 1207762-008 (in Dutch).

J.C. Rozemeijer, J. Klein, H.P. Broers, T.P. van Tol-Leenders & B. van der Grift (2014) Water quality status and trends in agriculture dominated headwaters; a national monitoring network for assessing the effectiveness of national and European manure legislation in The Netherlands. Published in Environmental Monitoring and Assessment

4. Scope of work

In the project goals and objectives four main questions are formulated to be answered in the Interpretive Report, the final report to be produced in this proposal, and which are abstracted from the Delta RMP Monitoring Design Summary. The four main goals are the following:

1 To what extent do pesticides contribute to the observed toxicity in the Delta?
2 Which pesticides or metabolites have the highest potential to be causing toxicity in the Delta and therefore should be the priority for monitoring and management?
3 What are the spatial and temporal extents of lethal and sub lethal aquatic and sediment toxicity observed in the Delta?
4 What are the spatial/temporal distributions of concentrations of currently used pesticides identified as likely causes of observed toxicity?

To answer these questions, a number of sub questions have to be answered first. In the following section the process of answering these questions according to our vision is laid down.

1. Stakeholder engagement

As mentioned in the Request for Proposal (RfP) stakeholder engagement is an important part of the project. Therefore we have included two face to face meetings with the stakeholders, d, which we will efficiently combine with the attendance of two relevant conferences, despite the fact that our team will operate from the Netherlands.
Our proposal starts with a kick-off meeting (via videoconferencing or telephone) to check each other's expectations regarding to the project and make further adjustments and agreements (Milestone M1.1). A response to the comments and feedback received during this meeting will be made available two weeks after the meeting (Milestone M 1.5). Further milestones and deliverables at which stakeholder engagement and input is anticipated are incorporated in the coming sections.

Milestone M.1.1 and M 1.2.: Kick off meeting (Month 1) and response to meetings
Milestone M1.3 - 1.8: milestone meeting and response to comments (various months see Table 1).
Deliverables: D1.3, D1.5 and D1.7: Presentation at meetings
Deliverables: D1.2, 1.4 and 1.6: Minutes of meetings with responses to meetings and deliverables presented

2. Construction of the definitive database

In a first step, the data to be used in the further analyses are determined. For this, a number of databases are already mentioned in the RfP. The results of Delta RMP, which are (partly) incorporated in the CEDEN database, are of course the most relevant. As an important additional data source, we propose to use the Surface Water Database (SURF) which is maintained by the California Department of Pesticide Regulation, see for further information http://www.cdpr.ca.gov/docs/emon/surfwtr/surfdata.htm. This database contains data from a wide variety of environmental monitoring studies designed to test for the presence of pesticides in California surface waters. The database has recently been updated, now also containing data from the CEDEN database and the NWIS database of the United States Geological Survey. We are convinced that this database acts as a strong base for the initial set up of the definitive data set to be used.

As the SURF database only contains data until May 2017, data from both the CEDEN and NWIS database from May 2017 up till now will also be included in the initial data set. Besides, a literature review in the scientific literature is performed, as we are aware that also in the scientific literature papers exist concerning monitoring of pesticides in Californian waters[1]. Of course we also take into account the results of the monitoring program we perform ourselves at Staten Island.

Three different parameters are decisive in determining the definitive data set, namely the regional and the temporal boundaries of the data set and the quality of the data, originating from different sources.
For the temporal scope data from the above mentioned data sources ranging from 1-1-2011 till present are included, as mentioned in the RfP. The matrices to be taken into account are the water column (both dissolved and total) and the sediment.
In terms of the geographical scope we come up with a proposal of locations to be included, based upon the locations available in the different databases combined with the hydrology of the region. Regarding this aspect of the database especially, review and feedback of the stakeholders is crucial, as they have a long lasting experience in the Delta region.

We are aware of the fact that already an extensive quality assurance has taken place on the several data sets (i.e. The Delta RMP Quality Assurance Program Plan), but that most probably also differences in quality assurance will exist between the different monitoring programs and data bases, influencing the use and the interpretation of the data. Therefore an in-depth analysis of the parameters taken into account between the different quality assurances plans related to the several data sets is performed. Based on this analysis, a selection of definitive data set is made. It is important to stress here that the quality assurance parameters to take into account for the toxicity results as well as for the chemical analyses are different, and will therefore be treated separately. The methodology, principles, and information used on how the definitive data set is accomplished will be described in a memo, next to a summary of the metadata of the definitive database, displayed both in tables and in maps and/or graphs, where suitable. Typical metadata to be taken into account are the collector/owner of the samples, the sampling method (i.e. grab, passive or automated sampling), the method of analysis (both chemical and toxicological) used, the quality assurance performed on the analysis, reported detection limits and relevant climate and hydrological conditions. Typical analyses to be displayed concerning the definitive database are the number and location of monitoring points, the number of data points, both in total and per monitoring location, time trends in data available per year, both in total and per location, number and which compounds available in total per year and per location, number and which toxicity tests available in total per year and per location. Here, we will make use of the experience we have gained during the yearly evaluation of the Dutch national monitoring program on pesticides in interpreting and evaluating data. An example of this evaluation can be found in this report (only available in Dutch).
The eventual definitive database is delivered in an Excel file. The principles, methodology and metadata that are used to construct the final database will ne described in a technical memo. This memo will also include some basic visualisations.

Milestone M2.1: Finishing definitive data set, Excel file and technical memo (Month 4)

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[1] K. Starner, K.S. Goh (2012) Detections of the Neonicotinoid Insecticide Imidacloprid in Surface Waters of 3 Agricultural Regions of California, USA, 2010–2011. Bull Environ Contam Toxicol., vol. 88:316–321

From our experience from similar projects in which data sets had to be evaluated in terms of their quality and suitability, we anticipate that this will be a major and crucial task within the project. Assuming the project will start in May 2018, we propose to present and discuss the results of this first task during a meeting just before or after de Biannual Delta Bay conference, which will be held in Sacramento from 9-12 September 2018, and which we are planning to visit (Milestone 1.2). A response to the comments and feedback received during the meeting will be made available 2 weeks after the meeting (Milestone 1.3).

Deliverables:
D 2.1: a summary of the definitive data set.
D 2.2: Excel file containing the definitive database with both pesticide and toxicity results to be used in further analysis.
D 2.3: technical memo describing the principles, methodology and metadata used to construct the final database and displaying some basic visualisations.

3. Analysis of the definitive database

Before further analysis of the definitive database is made with respect to the question 1-4 raised in the RfP, there has to be agreement between contractor and client on the methods to be used for further analysing the data. Therefore a technical memo will be produced, proposing a number of methods to be used, building further on the preliminary analysis done on the metadata in the former step. Here we propose already some aspects to be taken in to account (Deliverable D 3.2).

As already mentioned in the RfP, answering question #1 is a major goal of the Interpretive Report, as in this question both the results of the chemical analysis and the performed toxicity tests come together. The major advantage of toxicity tests is that these take the adverse effects of (the combination of) all compounds, both parent and metabolites, into account. In order to explain the *observed toxicity* in the tests, the results have to be confronted with the potential adverse effects caused by the (combination of) pesticide concentrations observed (*potential toxicity*). As a consequence this can only be done for data points in the definitive database for which both chemical analyses and toxicity tests have been performed on the same location and at the same time.
For the comparison between observed and potential toxicity, different methods are available with varying complexity and accuracy. The rationale behind most of these methods is that the results of the chemical analyses, e.g. concentrations of pesticides are first translated into a potential risk caused by these concentrations. This is done by comparing the concentration of a compound with its appropriate water quality objective, resulting in a Toxic Unit (TU) per compound. In The Delta RMP Quality Assurance Program Plan a list of water quality objectives is already given for a substantial amount of pesticides for the three most important trophic levels, namely primary producers (algae), invertebrates and fish. This enables us to calculate a TU per trophic level, e.g a TU_{fish}, a $TU_{invertebrate}$ and a $TU_{primary\ producer}$ per compound. Subsequently, the values for the individual substances are summed to one sum of TU's (ΣTU-value) for each trophic level per location. Eventually these ΣTU-values are compared with the observed toxicity for each of these trophic levels (*Selenastrum capricornutum*, *Ceriodaphnia dubia* and *Pimephales promelas*). In this way the analyses can be done if the observed toxicity can be explained by the pesticides measured.
Then, a more sophisticated way of relating the observed toxicity with the potential toxicity is performed by using the multisubstance Potentially Affected Fraction (msPAF) approach as we

have also done before in this study. This method makes use of the available toxicity data for a substance or an environmental sample for all species of which ecotoxicity data are known, instead of taking the lowest or geomean of the base set species. Available data are assumed to be a representative sample from the distribution of sensitivities towards a substance in an ecosystem. The data can then be used to calculate the proportion of species at risk at a certain concentration, the Potentially Affected Fraction (PAF). The PAF values for single substances are combined into the mixture toxic pressure for a sample, the msPAF value. The results of the performed toxicity test can also be translated into a PAF fraction per environmental sample. In this way both observed and potential toxicity can be compared with each other using the same parameter, a methodology we have already performed in this study. For this, we have databases and methods in place, which are already developed in other projects.

As mentioned before, a list of water quality objectives is already decided upon within the Delta RMP Quality assurance Plan. However, this list is not complete and exhaustive. Besides, this list was established in 2016 and we are aware of the fact that some of the water quality objectives are already outdated. For example the values for imidacloprid have been updated in 2017. Therefore, we propose to construct an updated and completed list of water quality objectives before performing further analyses. For this a number of relevant databases are scrutinized, e.g. the EPA database[2] and water quality reports originating from the Californian Department of Pesticide Regulation[3]. A special attention is needed regarding sediment quality objectives, as no compiled list of these values is readily available. As we have read from the external review response these sediment toxicity benchmark concentrations are assembled from various sources, but this is an issue we would gladly like to discuss with the stakeholders. An updated list will first be discussed with the RMP stakeholders before used in further analysis (Deliverable D 3.1).

Using the aforementioned TU and msPAF methodologies also enables attributing the contribution of the different constituents within the mixture of compound to both the overall potential risk calculated. This can be done for the separate locations and years, but also for the total Delta region or different regions of the Delta. In this way a prioritization can be made of the compounds which in potential have the most environmental impact and should be treated first in terms of further monitoring or management options, thereby answering *question #2* and *#4* in the RfP.

From the studies and the experience we have gained throughout the years, we know that some relevant pitfalls are present in the comparison between the observed toxicity (based on the toxicity tests) and the potential toxicity (based on chemical analyses). Here we will touch upon a few important ones.
On the chemical site, the choice of the compounds analyzed can be a crucial delimitation. Compounds which were present but not analyzed do not play part in the calculation of the potential toxicity (TU and ms PAF) but contributes to the response in de toxicity test. This hampers the relationship between potential and observed toxicity. These not analyzed compounds could be pesticides but also other substances. As far as we know, no other compounds have been analyzed additionally in the Delta RMP. Also the absence pf reliable

[2] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-pesticide-registration
[3](https://www.waterboards.ca.gov/rwqcb5/water_issues/tmdl/central_valley_projects/central_valley_pesticides/criteria_method/index.shtml

water quality objectives for certain compounds may have a big effect on the observed relationship between data from chemical analysis and toxicity tests.
With respect to the toxicity tests, it may be that the tests used are not suitable to detect the adverse effect of the compounds present. It can be that either the effects will only be displayed upon chronic exposure and the tests executed are on an acute basis, or that the test species are not suitable for detecting the adverse effects caused by a certain compound. Regarding the last reasoning, it is known that insects are far more sensitive to exposure to neonicotinoids than crustaceans, but insects are in general not included in the toxicity tests performed.
Having read the Independent Panel Review of the first phase of the Delta RMP Monitoring Design and a quick analysis of the results from the first round of the Delta RMP abstracted from the CEDEN website learns that indeed the amount of observed toxicity is low, comparable with the results we found in the Netherlands. This would greatly hamper the relationship between observed and potential toxicity, an important issue to address and to discuss with the RMP stakeholders.
The observed toxicity results will be presented per year and per location. Based on these results potential hotspots will be identified, indicating high toxicity, thereby answering *question #3* in the RfP. For those locations for which no chemical analyses have been performed, potential problem compound groups will be identified based on their mode of action (herbicides, insecticides, fungicides), based on the specific toxicity observed (algae, invertebrates, fish).

We propose to present and discuss with stakeholders the draft analysis methods just before or after the SETAC Annual Meeting, which will be held in Sacramento from 4-8 November 2018, which we intend to visit (Milestone 1.5). The draft analysis method (Deliverable D 3.2) will be distributed 2-3 weeks before the meeting. A response to the comments and feedback received at the meeting will be made available 2 weeks after the meeting (Milestone 1.6). A final report on the analysis methods will be made available in the beginning of December (Deliverable 3.2).

Deliverables:
D 3.2 Draft memorandum on analytical methods to be used
D 3.3: Final memorandum on analytical methods to be used

4. Draft and final interpretive report

Based on the final analysis methods agreed (Deliverable D3.3), the data set agreed (Deliverable D 2.2) will be analyzed. A first draft outline of the report (Deliverable D.4.1). will be presented and discussed with the stakeholders during the scheduled face to face meeting in September (Milestone M1.3). The comments and feedback on the draft report will be incorporated in a next draft of the report. The final draft report will be delivered at the end of February 2019 (Deliverable D.4.2) and will be discussed during a videoconferencing or telecom meeting (Milestone 1.4). The comments and feedback is made available 2 weeks after the meeting (Milestone M 1.8) and will be incorporated in the final report (Deliverable D4.3) at the end of the project, anticipated to be at the end of April 2019. The final report is reviewed internally according to the Deltares' Quality Management System, which is an ISO 9001 certified system.

On the next page a timeline of the scope of work is displayed, including the milestones and deliverables. The abbreviations refer to the abbreviations used in the different sections. The arrows indicate a transfer from information and/or knowledge.

Project month 1	1	2	3	4	5	6	7	8	9	10	11	12
task	May	June	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April
1. stakeholder engagement & input												
1.1 meetings	D1.1				D1.3		D.1.5				D1.7	
1.2 response to meetings	D1.2				D1.4		D1.6				D1.8	
2. compilation of existing data & literature												
2.1 summary and evaluation of existing data				D.2.1								
2.2 database of pesticide & toxicity data				D.2.2								
2.3 memo with basic data vizualisations				D.2.3								
3. Analysis methods												
3.1 updated list of water quality objectives					D3.1							
3.2 draft method of analytical methods						D.3.2						
3.3 final method of analytical methods							D.3.2					
4. intrepretive report												
4 analysis of data according to agreed methods												
4. Interpretive report				D.4.1						D.4.2		D.4.3

Timeline of the scope of the work proposed

5. Cost of Services

The total budget to be charged for this project is 77.450,- USD, including all direct and indirect costs. A breakdown in budget per task is given in the following table

Task	Budget (USD)	Anticipated labour hours
task 1: stakeholder engagement	14 472	Erwin Roex, 40 hours, Janneke Klein 8 hours, Jasperien de Weert 8 hours Joachim Rozemeier 8 hours
task 2 construction definitive database	25 758	Janneke Klein, 74 hours Jasperien de Weert 12 hours, Joachim Rozemeijer, 12 hours, Erwin Roex, 32 hours
task 3: analysis methods	13 464	Erwin Roex, 24 hours Janneke Klein, 24 hours Jasperien de Weert, 8 hours Joachim Rozemeijer 8 hours
task 4: analysis and report	23 756	Janneke Klein, 64 hours Erwin Roex, 24 hours Jasperien de Weert 12 hours Joachim Rozemeijer 12 hours Internal review 8 hours

The hourly rate of Erwin Roex, Jasperien de Weert and Joachim Rozemeijer is 234 USD, the hourly rate for Janneke Klein is 171 USD, the hourly rate for the internal review is 197.5 USD.

6. Conflict of interest Statement

Deltares has not provided services or entered into contracts in the past five years with any of the Delta RMP contributors listed in Attachment A of the request for Proposal.